# PLUMBING II

## COURSE DESCRIPTION

***Plumbing II* is a course in which students will extend their skills and knowledge related to residential and commercial plumbing. Topics covered include physics principles, fuel piping systems, pressure reducers, backflow preventers, troubleshooting and repair, DWV piping, vents, and drainage. This course gives students a substantial skill and knowledge foundation typically required for apprentice plumbers.**

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| **Prerequisite(s):** | Plumbing I, Algebra I or Math for Technology II<br><br>Geometry, Principles of Technology I or Physical Science (may be concurrent) |
| **Recommended Credits:** | 2 |
| **Recommended Grade Level(s):** | $12^{th}$ |

## PLUMBING II STANDARDS

1.0 Students will demonstrate leadership, citizenship, and teamwork skills required for success in the school, community, and workplace.

2.0 Students will assume responsibility for the safety of themselves, their coworkers, and bystanders.

3.0 Students will interpret, lay out, and fabricate in conformance to construction drawings and written specifications.

4.0 Students will relate principles of physics to the operation of plumbing systems.

5.0 Students will examine special considerations required for fuel systems in commercial and residential structures.

6.0 Students will install and maintain pressure-reducers and backflow preventers.

7.0 Students will troubleshoot and repair fixtures, valves, and faucets.

8.0 Students will install and test DWV piping.

9.0 Students will size and construct vents for a DWV system.

10.0 Students will determine the size of storm drain system needed to serve a structure.

## PLUMBING II

### STANDARD 1.0

Students will demonstrate leadership, citizenship, and teamwork skills required for success in the school, community, and workplace.

### LEARNING EXPECTATIONS

The student will:

1.1 Demonstrate leadership skills.
1.2 Use problem-solving techniques to address and propose solutions to school, community, and workplace problems.
1.3 Demonstrate the ability to work professionally with others.
1.4 Participate in SkillsUSA-VICA as an integral part of instruction.

### PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET

The student:

1.1.A Exhibits integrity and pride in workmanship.
1.1.B Keeps group work focused on task.
1.2.A Determines the root causes of observed conflicts or problems.
1.2.B Mediates disputes between parties.
1.3.A Participates in a job shadowing experience.
1.3.B Assembles a student team to solve an assigned problem.
1.4.A Attends and participates in periodic meetings of SkillsUSA-VICA or similar organization.

### SAMPLE PERFORMANCE TASKS

- Prepare a resume.
- Participate in various SkillsUSA-VICA or similar programs and/or competitive events.
- Attend a professional organization meeting, such as, local Chamber of Commerce meeting.
- Participate in the American Spirit Award competition with SkillsUSA-VICA.
- Participate in job shadowing or internship program with local business or industry.
- Take an active role in a group project assigned by the instructor.
- Identify and detail a problem area in the school, community, or workplace, and propose solutions. If possible, and with appropriate approvals, implement or facilitate the solution.

### INTEGRATION LINKAGES

SkillsUSA-VICA, *Professional Development Program,* SkillsUSA-VICA, Communication and Writing Skills, Teambuilding Skills, Research, Language Arts, Sociology, Psychology, Algebra, Geometry, Applied Communication, Social Studies, Problem Solving, Interpersonal Skills, Employability Skills, Critical-Thinking Skills, SCANS (Secretary's Commission on Achieving Necessary Skills), Chamber of Commerce, Colleges, Universities, Technology Centers, and Employment Agencies

## STANDARD 2.0

Students will assume responsibility for the safety of themselves, their coworkers, and bystanders.

## LEARNING EXPECTATIONS

The student will:

2.1 Exhibit and encourage in others a positive attitude regarding safety practices and issues.
2.2 Habitually inspect and use appropriate personal protective equipment for assigned tasks.
2.3 Inspect, maintain, and employ safe operating procedures with tools and equipment, such as soldering and brazing equipment, lifting equipment, and high pressure gas containers.
2.4 Exhibit a well-developed awareness of potential hazards to themselves and others.
2.5 Carry out responsibilities under HazCom (Hazard Communication) regulations.
2.6 Take action to protect coworkers and bystanders from hazards as required by regulations and company policies.
2.7 Report accidents and observed hazards and execute emergency response procedures as required by regulations, and company policies.
2.8 Demonstrate appropriate related safety procedures.

## PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET

The student:

2.1.A Includes safety procedures in activity plans.
2.1.B Exhibits an awareness of proper safety procedures by coworkers.
2.1.C Responds positively to instruction, advice, and correction regarding safety issues.
2.1.D Reports to school or work physically ready to perform to professional standards, such as rested, or not impaired by medications, drugs, alcohol, and so forth.
2.2.A Selects, inspects, and uses the correct personal protective equipment for the assigned task.
2.3.A Checks soldering and brazing torches for leaks, prior to use.
2.3.B Inspects extension cords for the presence of a functional ground connection, prior to use.
2.3.C Properly caps and handles compressed gas, fuel, and refrigerant tanks.
2.4.A Is observant of personnel and activities in the vicinity of their work area.
2.4.B Warns nearby personnel, prior to starting potentially hazardous actions.
2.5.A Applies information from MSDSs (material safety data sheets) to protect self and others from the health hazards associated with assigned tasks.
2.5.B Reports hazards found on the job site to the supervisor and remedies the hazard as instructed.
2.6.A Monitors air quality during soldering and brazing operations.
2.6.B Provides and activates adequate ventilation equipment as required by the task.
2.7.A Reports all injuries and observed unguarded hazards to the immediate supervisor.
2.7.B Execute assigned tasks as described in emergency response procedures.
2.8.A Passes with 100 % accuracy a written examination relating to safety issues.
2.8.B Passes with 100% accuracy a performance examination relating to safety.
2.8.C Maintains a portfolio record of written safety examinations and equipment examinations for which the student has passed an operational checkout by the instructor.

## SAMPLE PERFORMANCE TASKS

- Prior to assigning a task using power tools, the instructor removes some required safety items and instructs students to perform an inspection of tools.
- Instruct a visitor to obviously approach the vicinity of a student conducting a hazardous activity and note the level of awareness demonstrated by the student.
- In a project requiring solvents or adhesives, introduce a new brand or type, and require students to retrieve the MSDS and identify possible health hazards.

## INTEGRATION/LINKAGES

Science, Computer Skills, Research and Writing Skills, Language Arts, Algebra, Geometry, Communication Skills, Leadership Skills, Teamwork Skills, Applied Communication, Secretary's Commission on Achieving Necessary Skills (SCANS), Skills USA-VICA, Associated Builders and Contractors (ABC), Associated General Contractors (AGC), National Center for Construction Education and Research (NCCER), Occupational Safety and Health Administration (OSHA), Environmental Protection Agency, United States Department of Labor and Workforce Development and Workforce Development, Tennessee Department of Labor and Workforce Development and Workforce Development, Plumbing, Heating, and Cooling Contractors (PHCC)

## PLUMBING II

### STANDARD 3.0

Students will interpret, lay out, and fabricate in conformance to construction drawings and written specifications.

### LEARNING EXPECTATIONS

The student will:

3.1 Scale dimensions that are not explicitly included in construction drawings.
3.2 Interpret plan and elevation views shown in construction drawings.
3.3 Recognize and interpret lines and symbols commonly used in construction drawings.

### PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET

The student:

3.1.A Uses the scale of a drawing to determine locations not explicitly dimensioned.
3.1.B Uses the scale of a drawing to determine dimensions not explicitly shown on drawing.
3.2.A Interprets three-dimensional features found in construction drawings.
3.3.A Readily relates plumbing components and piping connections with symbolic components and piping symbols in construction drawings.

### SAMPLE PERFORMANCE TASKS

- Given a set of plans and specifications for a residential or commercial structure, make a complete material take-off for the plumbing components.
- Given a set of plans and specifications for a residential or commercial structure, determine the location of plumbing elements not explicitly dimensioned.
- Determine the detail of specified routing and structural supports for DWV piping shown in construction drawings.

### INTEGRATION/LINKAGES

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## PLUMBING II

### STANDARD 4.0

Students will relate principles of physics to the operation of plumbing systems.

### LEARNING EXPECTATIONS

The student will:

4.1 Relate pressure difference in a system to the flow rate through the system.
4.2 Discuss the role of viscosity and flow rate on pressure drop in a plumbing system.
4.3 Analyze the role of hydrostatic pressure in water delivery systems.
4.4 Relate Boyle's Law to the changes in gas pressure in plumbing systems.
4.5 Relate Archimedes Principle to buoyant forces experienced by plumbing systems.
4.6 Relate the concepts of momentum and impulse to the control of water flow in plumbing systems.

### PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET

The student:

4.1.A Calculates the maximum expected flow rate for a given fluid, pipe run, and pressure difference.
4.1.B Calculates the required pipe size for a given pipe run, applied pressure, and requiring a specified flow rate.
4.2.A Calculates the required pipe size for a given pipe run, applied pressure, and specified flow rate, for a fluid other than water.
4.2.B Describes the relationship between a fluid's viscosity and required pipe size for a given pipe run, applied pressure, and specified flow rate.
4.3.A Relates the benefits of hydrostatic pressure provided by a water tower in distribution systems.
4.3.B Relates the difficulties caused by hydrostatic pressure in delivery of water in multistory buildings.
4.4.A Explains the operation of air chamber shock arrestors, as it relates to Boyle's Law.
4.5.A Calculates the potential buoyant force on underground tanks.
4.6.A Explains how water-hammer can generate potentially dangerous high pressure in water systems.

### SAMPLE PERFORMANCE TASKS

- Experimentally investigate pressure drop and flow rate for liquids of different viscosities in a long run of small flexible pipe.
- Experimentally investigate delivery pressure loss for a hose hoisted to various elevations, e.g., up a stairwell.
- Design and build a water hammer and shock arrestor demonstration, including pressure measuring devices, and observe the effects of different valve-closure rates.
- Given plans and specifications for installing an underground home heating oil tank, determine what provisions have been taken to protect the tank from buoyant forces.

## INTEGRATION/LINKAGES

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## PLUMBING II

### STANDARD 5.0

Students will examine special considerations required for fuel systems in commercial and residential structures.

### LEARNING EXPECTATIONS

The student will:

5.1 Describe the major types of fuel systems.
5.2 Demonstrate procedures for testing and purging of fuel system piping, and the reasons for doing so.
5.3 Compare and contrast the hazards and benefits of fuel systems using natural gas, LPG, and fuel oil.
5.4 Compare and contrast piping systems allowed by code for use with different fuels.
5.5 Comprehend the requirements for combustion air supply and combustion product venting.

### PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET

The student:

5.1.A Differentiates the major fuel types and their significant characteristics.
5.2.A Demonstrates testing and purging of piping for fuel systems.
5.2.B Explains the potential consequences of fuel line leaks or presence of air in fuel system piping.
5.3.A Describes why butane and propane are considered more hazardous than natural gas.
5.3.B Describes the environmental hazards posed by fuel oil piping and tanks.
5.3.C Compares and contrasts the effects on air quality of the burning of natural gas, LPG, and fuel oil.
5.4.A Determines possible material choices for fuel piping, given residential construction plans and specifications and a specified fuel.
5.4.B Determines the proper fuel pipe size, for a given application.
5.5.A Explains the hazards produced by inadequate combustion air supply.
5.5.B Explains the hazards produced by inadequate venting of combustion products.

### SAMPLE PERFORMANCE TASKS

- Given a specified fuel pipe run, fuel specification, and furnace BTU rating, determine the fuel pipe size.
- Given a real or mockup rough-in for a gas supply system, conduct a leak test on the piping.
- Given a completed real or mockup gas supply system, purge the system.
- Contact a local fuel gas supplier to determine the heat content of their product.

### INTEGRATION/LINKAGES

Science, Computer Skills, Research and Writing Skills, Language Arts, Algebra, Geometry, Communication Skills, Leadership Skills, Teamwork Skills, Applied Communication, Secretary's Commission on Achieving Necessary Skills (SCANS), Skills USA-VICA, Associated Builders and Contractors (ABC), Associated General Contractors (AGC), National Center for Construction Education and Research (NCCER), Occupational Safety and Health

Administration (OSHA), Environmental Protection Agency, United States Department of Labor and Workforce Development, Tennessee Department of Labor and Workforce Development, Plumbing, Heating, and Cooling Contractors (PHCC)

## PLUMBING II

### STANDARD 6.0

Students will install and maintain pressure-reducers and backflow preventers.

### LEARNING EXPECTATIONS

The student will:

6.1 Use pressure-reducing valves to reduce pressure in water supply systems.
6.2 Use various backflow prevention devices in water supply systems.

### PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET

The student:

6.1.A Installs pressure-reducing valves and associated by-pass components.
6.1.B Adjusts pressure-reducing valves.
6.1.C Maintains pressure-reducing valves.
6.2.A Explains the need for backflow preventers in water supply systems.
6.2.B Compares and contrasts the types of backflow preventers and their proper application.
6.2.C Installs, tests, and maintains backflow preventers in real or mock-up water supply systems.

### SAMPLE PERFORMANCE TASKS

- Construct, adjust, and test a mock-up pressure reducing system, equipped with appropriate gages.
- Construct and demonstrate the operation of a mock-up backflow preventing system.

### INTEGRATION/LINKAGES

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## PLUMBING II

### STANDARD 7.0

Students will troubleshoot and repair fixtures, valves, and faucets.

### LEARNING EXPECTATIONS

The student will:
7.1 Troubleshoot common failures in fixtures, valves, and faucets.
7.2 Repair and maintain fixtures, valves, and faucets.

### PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET

The student:
7.1.A Determines the specific cause for leaks and malfunctions in residential and commercial fixtures.
7.2.A Use proper procedures to repair or replace malfunctioning fixtures, valves, and faucets.
7.2.B Use proper procedures to maintain fixtures, valves, and faucets.

### SAMPLE PERFORMANCE TASKS

- Disassemble and demonstrate repair of common faucets.
- Disassemble and demonstrate repair of valves typically used in commercial systems.

### INTEGRATION/LINKAGES

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## PLUMBING II

### STANDARD 8.0

Students will install and test DWV piping.

### LEARNING EXPECTATIONS

The student will:

8.1 Locate all rough-in components in residential or commercial DWV systems.
8.2 Install carriers common to residential or commercial construction.
8.3 Install sewer pipe at a specified grade.
8.4 Install vents.
8.5 Test and inspect DWV piping.

### PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET

The student:

8.1.A Determines the plan location and elevation for rough-in piping and carriers.
8.1.B Chooses appropriate locations for the main stack and other vents.
8.1.C Calculates the elevation of the main stack sweep.
8.2.A Demonstrates the installation of carriers on a real or mock-up structure.
8.3.A Determines required grade from construction drawings, specifications, local codes, or local plumbing inspector.
8.3.B Determines the elevation of each end of the pipe, for a given run of drain pipe.
8.3.C Installs pipe with appropriate hangers, clamps, and supports, or lay in a prepared trench.
8.4.A Demonstrates the installation of vents and main stack on a real or mock-up structure.
8.5.A Demonstrates, as to a plumbing inspector, water and air tests on DWV piping.

### SAMPLE PERFORMANCE TASKS

- On a real or mock-up structure, mark the location and elevation of rough-in components on a slab foundation, as shown by construction drawings and specifications, or acceptable trade practice.
- On a real or a mock-up framed structure, mark the location and elevation of rough-in components, as shown by construction drawings and specifications, or acceptable trade practice.
- On a real or a mock-up framed structure, install fixture carriers and vents, as shown by construction drawings and specifications, or acceptable trade practice.
- On a real or a mock-up second-floor structure, install a drain line to appropriate grade using appropriate hangers.
- On a real or a mock-up DWV piping system, perform a water and air test while being observed by a plumbing inspector.

### INTEGRATION/LINKAGES

Science, Computer Skills, Research and Writing Skills, Language Arts, Communication Skills, Leadership Skills, Teamwork Skills, Applied Communication, Associated Builders and Contractors (ABC), Associated General Contractors (AGC), National Center for Construction Education and Research (NCCER), Occupational Safety and Health Administration (OSHA), Environmental Protection Agency, United States Department of Labor and Workforce

Development, Tennessee Department of Labor and Workforce Development, Plumbing, Heating, and Cooling Contractors (PHCC), NCCER 02203

## PLUMBING II

### STANDARD 9.0

Students will size and construct vents and drains for a DWV system.

### LEARNING EXPECTATIONS

The student will:

9.1 Comprehend the need for vents in a DWV system.
9.2 Construct DWV vents and drains according to construction drawings and local code requirements.
9.3 Select appropriate type of vent for a given fixture.
9.4 Select proper sized vent and drain for a given group of fixtures.

### PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET

The student:

9.1.A Explains the consequences of back-pressure in a DWV system.
9.1.B Explains the consequences of a partial vacuum in a DWV system.
9.2.A Installs DWV vents on a real or mock-up structure according to construction drawings and local code requirements.
9.2.B Installs drains on a real or mock-up structure according to construction drawings and local code requirements.
9.3.A Compares and contrasts possible vent structures, given the location of fixtures.
9.4.A Determines minimum acceptable vent size for a group of fixtures served by a vent, according to code and trade practice.
9.4.B Determines minimum acceptable drain size for a group of fixtures served by a common drain, according to code and trade practice.

### SAMPLE PERFORMANCE TASKS

- On a mock-up operating DWV system, demonstrate trap siphoning caused by vent blockage.
- Given a list of plumbing fixtures to be served by a single vent, determine the minimum size of the required vent.
- On a real or mock-up framed structure, install a specified vent configuration.

### INTEGRATION/LINKAGES

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## PLUMBING II

### STANDARD 10.0

Students will determine the size of storm drain system needed to serve a structure.

### LEARNING EXPECTATIONS

The student will:

10.1 Determine maximum volume flow rate that must be handled by a storm drain system.
10.2 Determine the required size of vertical leaders and storm drains.

### PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET

The student:

10.1.A Predicts the maximum expected 24-hour rainfall volume for a given location based on a 30-year average.
10.1.B Calculates the area and storage volume of the given structure's roof.
10.1.C Determines the maximum required roof drain flow rate.
10.2.A Determines the required size of vertical leader and storm drain, for a given maximum flow rate and drain slope.

### SAMPLE PERFORMANCE TASKS

- For a given location, look up historical weather data and estimate maximum 24-hour rainfall.
- For a given roof plan, calculate the area and storage volume.
- For a given roof plan and building location, determine the number and size of vertical leaders and size of storm drain.

### INTEGRATION/LINKAGES

Science, Computer Skills, Research and Writing Skills, Language Arts, Communication Skills, Leadership Skills, Teamwork Skills, Applied Communication, Secretary's Commission on Achieving Necessary Skills (SCANS), Skills USA-VICA, Associated Builders and Contractors (ABC), Associated General Contractors (AGC), National Center for Construction Education and Research (NCCER), Occupational Safety and Health Administration (OSHA), Environmental Protection Agency, United States Department of Labor and Workforce Development, Tennessee Department of Labor and Workforce Development,, Plumbing, Heating, and Cooling Contractors (PHCC), NCCER 02213

## PLUMBING II

**SAMPLING OF AVAILABLE RESOURCES**

- National Center for Construction Education and Research (NCCER), *Core Curriculum*. Prentice Hall, Upper Saddle River, NJ; ©2000. Also known as the "Wheels of Learning" materials.
- National Center for Construction Education and Research (NCCER), *Plumbing Level One*. Prentice Hall, Upper Saddle River, NJ; ©2000. Also known as the "Wheels of Learning" materials.
- National Center for Construction Education and Research (NCCER), *Plumbing Level Two*. Prentice Hall, Upper Saddle River, NJ; ©2001. Also known as the "Wheels of Learning" materials.
- National Center for Construction Education and Research (NCCER), *Plumbing Level Three*. Prentice Hall, Upper Saddle River, NJ; ©1993. Also known as the "Wheels of Learning" materials.
- National Center for Construction Education and Research (NCCER), *Plumbing Level Four*. Prentice Hall, Upper Saddle River, NJ; ©1993. Also known as the "Wheels of Learning" materials.